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ABSTRACT

This document contains part one of a report of projects undertaken through the Hilroy Fellowship Program in Canada in 1970-71. The stated aim of the program is to encourage and reward classroom teachers who are developing new ideas for the improvement of teaching practices. The three projects reported in this document deal with mathematics and natural sciences education. Each project description contains the following information: (1) the name and address of the teacher; (2) the name and address of the school; (3) a review of the project, including the title, purpose, age, and significant characteristics of the pupils, procedures followed, modifications, source or resource materials, and evaluation procedures used; and (4) general comments about the project. The projects are a program for developing a three-year junior high school program in mathematics with a major emphasis on continuous progress and individualized instruction, a program for teaching science to native indian students, and a fourth grade environmental study program. (RC)

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INNOVATIONS IN TEACHING 1970-71

PART I

Hilroy Fellowship Projects

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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C-71303

INNOVATIONS IN TEACHING

OF

MATHEMATICS AND NATURAL SCIENCES

Projects of the

Hilroy Fellowship Program

1970-71

administered by

THE CANADIAN TEACHERS' FEDERATION TRUST FUND
Suite 2010, 320 Queen Street
Ottawa, Ontario
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THE HILROY FELLOWSHIP PROGRAM

FOREWORD:

The Hilroy Fellowship Program was established in 1969 by the Roy C. Hill Charitable Foundation and is administered by the Canadian Teachers' Federation Trust Fund. The aim of the Program is to encourage and reward active classroom teachers who are developing new ideas for the improvement of teaching practices.

Teachers who are working at any level in an elementary or secondary school and who are devising new methods, new approaches or new teaching devices, are invited to apply for Fellowships. Small groups of teachers working as a team under the chairmanship of a coordinator are also eligible. Application forms and related instructions may be obtained from the Secretary-Treasurer, CTF Trust Fund, Suite 2010, 320 Queen Street, Ottawa, Ontario K1R 5A3 or from Provincial or Territorial Teachers' Organizations. Applications may be in either English or French.

In each province a Provincial Advisory Council reviews applications and makes recommendations which are forwarded to the National Advisory Council. It, in turn, makes recommendations to the Roy C. Hill Charitable Foundation which makes the final selections.

Hilroy Fellowships are intended to reward the initiative and the professional enterprise of the classroom teacher and to make some contribution toward out-of-pocket expenses in the development of experimental and innovative approaches. It is not necessary, however, that expenses of any kind be involved. Generally speaking, the amount of each award is in the range from $800 to $1,500.

Payment of awards is made in three instalments, the first at the time of approval of the award, the second and third on the receipt of satisfactory interim and final reports on the implementation of the project. A Hilroy Fellowship Certificate is also awarded at the time of the third payment.

While the stated purpose of the Hilroy Fellowship Program is to encourage and reward the innovative classroom teacher, it may be considered to have a more out-reaching objective -- namely, the fostering of improved teaching practices for the general improvement of education. In keeping with this objective, this publication is a compilation of the reports of innovative projects by classroom teachers, projects for which the innovators have been judged worthy of recognition by the award of a Hilroy Fellowship in the school year 1970-71. It is hoped that this publication will have a wide circulation, that many teachers will benefit from projects reported upon, and that these reports will encourage other teachers to experiment and to innovate.

Copies of this report are available without charge to practising teachers on request to the Secretary-Treasurer, CTF Trust Fund, Suite 2010, 320 Queen Street, Ottawa, Ontario K1R 5A3.

LE PLAN DE BOURSES HILROY

AVANT-PROPOS:

Le Plan de bourses Hilroy a été établi en 1969 par la Fondation de bienfaisance Roy C. Hill et est présentement administré par le Fonds fiduciaire de la Fédération canadienne des enseignants. Le but de ce plan est d'encourager et récompenser les enseignants qui, au cours de leur enseignement, développent de nouvelles idées en vue d'améliorer les méthodes d'enseignement.

Les professeurs tant du niveau primaire que du secondaire, qui projettent de nouvelles méthodes, de nouveaux moyens ou de nouvelles techniques d'enseignement sont invités à faire la demande pour une bourse. Des équipes d'enseignants, groupant cinq ou six professeurs, sous la présidence d'un coordonnateur sont également éligibles. Des formules d'inscription et les instructions détaillées peuvent être obtenues en écrivant au Secrétaire-trésorier, Le Fonds fiduciaire de la FCE, Suite 2010, 320, rue Queen, Ottawa, Ontario K1R 5A3, ou l'Organisation provinciale ou territoriale. Les formulaires de demande peuvent être obtenus en anglais ou française.

Dans chaque province, un Conseil consultatif provincial examine les propositions, fait les recommandations et les envoie au Conseil consultatif national. Ce dernier fait les recommandations à la Fondation de bienfaisance Roy C. Hill qui fait la sélection finale.

Le Plan de bourses Hilroy veut récompenser les professeurs pour l'initiative et l'esprit professionnel qu'ils ont développés en menant à bonne fin une importante innovation en éducation; il veut également contribuer au coût des dépenses que représente le développement de techniques expérimentales. Cependant, il n'est pas nécessaire qu'aucune dépense soit encourue pour le projet. D'une manière générale, le montant de chaque récompense varie entre $800 et $1,500.

Le paiement des subventions est fait en trois versements, le premier au moment du décernement de la bourse, les deux autres sont faits lorsque le rapport intérimaire et le rapport final sont mis à exécution. Un certificat d'associé Hilroy est également attribué lorsque le dernier paiement est fait.

Comme indiqué plus haut, le but principal du Plan Hilroy est d'encourager et récompenser l'initiative des professeurs de classe. Ce projet a également un but plus définitif, c'est-à-dire, d'innover de nouvelles méthodes d'enseignement pour le progrès de l'éducation. Gardant cet objectif en tête, ce volume est un recueil de tous les rapports expérimentés par des enseignants, projets qui ont été jugés dignes de reconnaissance du Plan Hilroy pour l'année scolaire 1970-71. Nous espérons que cette publication circulera partout, que tous les professeurs bénéficieront de ces idées nouvelles, et que ces rapports encourageront d'autres instituteurs à expérimenter de nouvelles méthodes.

Les enseignants peuvent se procurer sans frais des copies de ce rapport en s'adressant au Secrétaire-trésorier, Le Fonds fiduciaire de la FCE, Suite 2010, 320, rue Queen, Ottawa, Ontario K1R 5A3.

HILROY FELLOWSHIP PROJECT 1

1. Name and home address of teachers:

Alexis A. Bakeeff,
P.O. Box 83,
Canning, Nova Scotia.

John C. Reid,
R.R. No. 2,
Wolfville, Nova Scotia.

2. Name and address of school:

Cornwallis District High School,
P.O. Box 190,
Canning, Nova Scotia.

3. Review of Project

(a) Title:

A PROGRAM FOR DEVELOPING A THREE YEAR JUNIOR HIGH SCHOOL CONTINUOUS PROGRESS MATHEMATICS PROGRAM

(b) Purpose:

Development of a learner oriented, unified, continuous progress mathematics program for the three junior high school years (7-9). During 1970-71, our goal was to implement the first third of the program with two Grade 7 classes and measure its effectiveness. We also tried University of Illinois Committee on School Mathematics elementary algebra materials in Grade 9 algebra classes.

Specific objectives of the program:

Help each learner:

- towards a positive self concept by providing success oriented mathematical experiences.
- learn how to learn
- improve in ability to reason and think.
- develop a positive attitude towards mathematics.
- increase competence in computation and understanding of mathematical concepts. Achievement of computational competence is the academic prerequisite for taking algebra in Grade 9.

(c) Age and other significant characteristics of pupils:

Eight glasses were involved during the 1970-71 school year.

	Pilot classes	No. of learners	Control classes	No. of learners
Grade 7	2	70	2	68
Grade 9	4	106	-	-

Age range in Grade 7 classes: 12 to 14
Age range in Grade 9 classes: 14 to 16

Measured IQ scores: Mean non-verbal score, Grade 7 pilot classes: 102
Mean non-verbal score, Grade 7 control classes: 101

(d) Procedures followed (from inception until end of school year):

I. Content and materials. Six units, answer keys and tests were put together for the first year of the program (Gr. 7) during the 1970-71 school year:

Unit 1: Rational Number Review and Numeration
2: Measures and Measurement
3: Sets, Solution Sets and Signed Numbers
4: Whole Number Operations and Properties
5: Factoring and Primes
6: Operations with Fractional Numbers

Initially each unit was thought of as a 6 week course.

In assembling these units, materials were chosen that would:

1) be self teaching to a high degree, permitting each learner to proceed at her/his own pace.

2) be success oriented to a high degree, giving each learner opportunity to experience some satisfaction with his/her efforts in math, thereby building self-confidence and encouraging further effort in seeking further success.

3) have a high interest level.

4) provide each learner with opportunities to discover mathematical patterns and concepts for him/her self.

5) wherever possible require each learner to demonstrate understanding of concepts by inventing related examples and problems.

6) minimize reading difficulties by keeping instructions brief and frequently using examples to introduce patterns and concepts.

Materials reviewing computational skills were also introduced as a supplement to each unit.

Materials more suitable for slower learners were introduced in one class when needed.

The course content for the third year (Gr. 9) consisted of the topics usually included in a contemporary treatment of elementary algebra. The approach used was the one developed by the University of Illinois Committee on School Mathematics as presented on their "Teaching Guide for Elementary Algebra".

II. Classroom procedures. Since we wanted each learner to become actively involved in developing his own rate and style of learning, we replaced the conventional teacher dominated and controlled classroom with procedures which would encourage and allow individualized learning and progress.

- Whole class lecture and recitation type lessons were eliminated as the normal classroom situation in favor of having learners working individually or in small groups. This meant a high degree of freedom of movement within the classroom. For a change of pace, teacher-dominated whole group lessons were used occasionally to introduce patterns and concepts using the discovery approach. Another change of pace activity centered around solving unstructured problems in small groups. The class was divided up into groups of 5 or 6. A problem was presented to the entire class. It was the task of each group to develop a solution. After 10 to 15 minutes group solutions were discussed by the entire class. This activity was not used much due to a shortage of unstructured problems. It did seem to have interesting potential.

- Regular teacher made homework assignments were eliminated in favor of learners setting their own homework assignments based on their unit goals, other subject workload and interests.

- Learners helped learners on a regular, rotating basis. Three learners were assigned to this job each day. In addition, help could be obtained from a friend or the teacher.

- Other tasks were also handled by members of the class on a regular, rotating basis. These included obtaining materials not available in the classroom, passing out and collecting the folders containing each learner's current unit, issuing answer keys and other materials.

- We sought to establish and encourage a relationship between the members of the group such that desirable and undesirable behavior became a function of self control rather than teacher control. To this end learners were given some responsibility for making decisions about alternate methods of behavior.

- Evaluation of learner progress was based on the concept of continuous evaluation. We attempted to see each learners folder once per week and return corrected tests the next day. Concepts that appeared to lack mastery were usually discussed individually. This could also be done in large or small groups where necessary.

- Tests were taken whenever a learner reached a specified testing point within each unit. Our wish to have a separate testing area was not realized this year. We used the library, empty rooms, the hall, etc. Other tests, related to computational review, were given periodically to each class as a group.

- Learners demonstrating irresponsible use of class time were required to set short term (by the day or by the week) goals as long as poor use of time was in evidence.

- Learners evaluated their own performance at the end of each unit. This device was useful in helping each person look back at his own efforts. The terms of reference given to the class for self evaluation were too vague and need to be more specifically defined.

- Answer keys were available to learners for getting instant feedback on their progress. The answer keys contained answers to most of the questions and problems in the units. Certain problems throughout each unit did not have answers available. These were checked by the teacher and formed one part of our continuous evaluation.

- Team teching was used on several occasions when having two teachers work with a class seemed desirable, or if a past experience of a teacher was felt to be useful in the exposition of a concept.

- Team planning between the program originators was carried on at regular weekly meetings. These sessions were used to review and revise materials for inclusion in units as well as discussion of problems arising in the two experimental classes. Most modifcations to the program came out of these meetings.

- Support personnel who volunteered to assist, performed three different functions:

  1) Grade 12 students who acted as teacher aides in the classroom once or twice per week, depending on their own class loads.

  2) Grade 12 students who assisted with some of the out of class details related to the program, i.e., making answer keys, routine correcting, collating units, etc.

  3) An adult from the community who assisted with the production of units and other classroom materials.

- The teacher's role in the classroom generally fell into the following three categories:

  1) Checking progress of learners whose interest and motivation was not self sustaining.

  2) Helping individuals with their questions.

  3) Going back over material found to lack mastery. This was mostly done on an individual basis but on several occasions was also done with small groups.

- Each class in both the experimental and control programs were pre-tested in September using the mathematics subtests of the Metropolitan Achievement Test, Advanced Battery. They were also given a locally prepared, single statement attitude test. In June the four classes were post-tested using the same achievement test. All learners were asked to complete an attitude questionnaire. The questionnaire included the original statement given in September as well as three other questions related to the year's work in mathematics. Parents of children in the experimental classes were also asked to complete a questionnaire. Results of the testing program appear in the section on evaluation.

- We accept the proposition that learning is a uniquely individual process. Consequently, encouraging academic competition between learners is of questionable value. In an attempt to eliminate competition

between learners, our marking system was based on points earned rather than on percent. Each unit was assigned a point value as follows:

Unit 1:	120	points
2:	130	"
3:	150	"
4:	180	"
5:	200	"
6:	220	"
Year's work total	1000	"

The increasing scale was used to underline the increasing effort required as the year progressed. As work increases in difficulty, it is only natural that its value increase.

The point value for each unit was divided among the various work sheets and tests that make up the unit. Satisfactory completion of the unit was based on mastery. Mastery was defined as understanding the concept involved and being able to demonstrate the concept.

Overall evaluation of a unit was broken down into 3 categories: Content, Self and Teacher. Each of these was further sub-divided as follows:

	Category	% of Unit point value	Sub-category
1.	Content	60%	Work sheets - 35% Tests - 25%
2.	Self	18%	Good Habits Incentive - 9% ** Self Evaluation - 9%
3.	Teacher	22%	Following Directions - 11% Progress - 6% Neatness Incentive - 5% **

** The Good Habits Incentive, coming to class properly equipped, and the Neatness Incentive carried less weight with each succeeding unit until, after Unit 3, they were reduced to 0%. Their weight shifted to Self Evaluation in the first case and to Progress in the second.

To indicate achievement in a given unit, we preferred 3 marks: Conditional Mastery, Mastery and Independent Mastery. This notation would have been totally different to the one presently in use to report achievement. As a result we adapted our point system to

conventional letter grades for reporting term and final marks to parents. The scheme we used was as follows:

Letter grade:	F	D	C	B	A
% of points:	35	25	20	15	5
% range:	0-35	36-60	61-80	81-95	96-100
		Conditional Mastery		Mastery	Independent Mastery

At the beginning of each unit, each learner was encouraged to set a goal for himself. The three goals available were C, B and A. F and D were not mentioned by the teacher as possible goals. They were however possible marks if a learner's effort warranted them. If a learner's earned point total fell into the F or D range, the option of completing supplementary material in the weak areas was available for another chance at the point value in the mastery range. The above stemmed from the assumption that each individual has a natural motivation and desire to learn, and further, a failure has educational validity only if the opportunity to learn from ones mistakes (failure) is available to the learner.

The mark for the year's work is arrived at for each learner by taking the sum of all unit points.

(e) Modifications:

- Early in the year we found it impossible to evaluate each learner's progress as frequently as originally planned, and make up new units, all within the 6-week time limit set for each unit. In addition, the material in the initial unit turned out to be too easy for the average and above average learner. As a result interest lagged. Subsequent material became more challenging and answer keys for much of the material in the units were made available so that learners could correct much of their own work. Tests, both teacher corrected and learner corrected, were introduced at several points in each unit. With these modifications continuous evaluation became a more manageable and effective procedure. The 6-week concept was discarded for the remainder of the school year.

- Heterogeneous grouping of students in Grade 7 has been the standard mode of grouping for the past few years at this school. Our program was formed with this method of

grouping in mind. During the first term, a decision was made to stream Grade 7. This happened in January. To preserve the math project, streaming took place within the two experimental groups and within the two control groups. The change in grouping adversely affected the helper scheme in the bottom stream. There was an insufficiency of people willing to take on the task of helping.

The increased number of learners with low motivation in the bottom stream experimental class necessitated a more rigidly structured situation. The teacher of this group switched to teacher-dominated discussions of a topic followed by exercise sheets. The materials for this change in tactics were taken from the School Mathematics Study Group publication "Secondary School Mathematics - Special Edition". The material is designed for low achievers.

As the year progressed, experience with each self teaching unit was used to shape the format of succeeding units. Gradually, some of the learners in the bottom stream were given the improved units. By year's end, all of the people in the bottom stream were again following the original procedure.

- In our initial scheme, one algrebra Grade 9 class was chosen to use the UICSM algebra materials. The course for the remaining Grade 9 classes was based on the prescribed text. In order for the non-UICSM students to have a better experience with algebra 1, all Grade 9 classes using the prescribed text were switched to UICSM materials during the first term.

- Each learner's work was not evaluated as frequently as was deemed desirable. This was because of the need to spend time on collecting material for units and the actual production of units (preparing stencils, running off stencils and collating units). The situation improved as the format of units improved. However there was a year long conflict between the tasks of evaluation and unit production.

- Towards the end of the year a modification was introduced into the evaluation process. This was tried with some top stream learners. In the final test for each unit, the level of mastery was raised to a correct response of 70%. Learners not achieving mastery were given a prescription for supplementary work based on unmastered portions of the unit. Successful completion of prescribed material was followed by a re-test of unmastered items. The purpose of this modification was to improve the procedure used in giving failing learners an opportunity to profit from their mistakes.

(f) Source or resource materials:

Teaching Guide for Elementary Algebra: Shor-University of Illinois $3.00 S.

Discovery in Mathematics: Davis-Addison Wesley, $7.00 P.

Discovery in Elementary School Mathematics: Botel-Encyclopaedia Britannica, $6.50 H.

Mathematics with Number in Color series: Gattegno-Cuisenaire, $8.00 P.

Contemporary Motivated Mathematics series: Boston College Mathematics Institute, $50.00 H.

Curriculum Bulletin 113: Cincinnati Public Schools, $3.00 P.

Multi-Level Math materials: Trepanier-San Diego City Schools, $5.00 H.

Secondary School Mathematics, Special Edition: School Mathematics Study Group, $10.00 S.

Mathematics, Structure & Skills, First Book: SRA, $5.00 S.

Experiences in Mathematical Ideas: National Council of Teachers of Mathematics, $40.00 S.

Legend: S purchased by school
P acquired by teachers
H purchased with Hilroy grant

(g) Evaluation procedures used:

Evaluation of the program was based on:

1) Achievement of learners in experimental and control classes using the Metropolitan Achievement mathematics sub-tests on arithmetic computation and on problem solving and concepts.

2) Attitude of learners in experimental and control classes using a locally prepared questionnaire.

3) Attitude of parents towards their children's experimental math course using a locally prepared questionnaire.

4) Teacher's subjective evaluation.

Results obtained

1) Metropolitan Achievement tests (scores given are group mean scores).

Experimental Group Mean non-verbal IQ: 102			Control Group Mean non-verbal IQ: 101		
Sub-test: Arithmetic Computation					
	standard score	Grade Equivalent		standard score	Grade Equivalent
Sept. pre-test:	40	6.4	Sept. pre-test:	39	6.2
June post-test:	42	6.7	June post-test:	47	7.6
change:	+2	+0.3	change:	+8	+1.4
Sub-test: Problem solving and concepts					
Sept. pre-test	43	7.0	Sept. pre-test:	42	6.8
June post-test:	47	7.7	June post-test:	47	7.7
change:	+4	+0.7	change:	+5	+0.9

- The large difference between the change in grade equivalents in the computation sub-test indicates that the objective of improving computational skills was not reached by many learners in the experimental group.

- The absence of any difference in the grade equivalents for the problem solving and concepts sub-test suggests that the two groups reached approximately the same level of achievement.

- The way in which the January streaming may have affected the achievement test results is unknown.

- Two other factors need to be considered in analyzing the above test results:

  i. The most effective unit format and classroom procedures developed out of classroom experience. In retrospect it is clear that Unit 1 was a particularly weak unit. As a consequence of this, it is felt that the progress and achievement for the majority of learners was stronger at year's end than at the beginning.

  ii. There was a great deal of pressure on both teachers during the year as a result of having two major tasks to deal with. The time needed to evaluate student work continuously, as well as prepare units,

tests and answer keys necessitated ignoring lower priority items or, at best, giving them superficial treatment. The spiral review of computational skills was a task that received insufficient attention. It seems reasonable to assume that this had some effect on the results of the computation sub-test.

2) Learner attitude questionnaire

Question 1. (This question was asked in September and again in June.) "I like mathematics ____."

Possible answers	Experimental		change	Control		change
	Sept/70	June/71		Sept/70	June/71	
Always	14%	12%	-2%	18%	11%	-7%
Most of the time	40%	53%	+13%	32%	55%	+33%
Part of the time	22%	23%	+1%	32%	23%	-9%
Very little	18%	8%	-10%	10%	8%	-2%
Never	6%	3%	-3%	8%	3%	-5%

Comment: While the % of replies in each category is almost the same for both groups in June, the change in replies for "Most of the time" favors the control group. The changes in the other four categories favor the experimental group.

Question 2. Comparing this year's work in mathematics with other years, I liked this year ____.

Answer possible	% of each reply	
	Experimental	Control
Best	63%	46%
Least	10%	19%
Same	27%	35%

Comment: The trend of these replies can be taken as an indication of a more positive attitude towards mathematics on the part of the learners in the experimental group.

Question 3. Which word best describes how much mathematics you feel you have learned while in this class?

Answers possible	% of each reply Experimental	Control
A lot	55%	61%
Some	45%	35%
None	0%	4%

Comment: The answers to this question do not seem to show any significant trend.

Question 4. I studied and worked on units/homework ____.

Answers possible	% of each reply Experimental (units)	Control (homework)
Frequently	20%	51%
Once in a while	65%	40%
Never	15%	9%

Comment: In considering the results to this question, one needs to be aware of the difference in homework policy for each group. Learners in the control group were expected to complete regularly assigned home lessons. Learners in the experimental group set their own goals. For each learner this meant a personal decision as to whether or not they needed to work on their units at home. Those who did not use time in a responsible way were required to register their decisions with the teacher on a daily or weekly basis.

3) Parents attitude questionnaire, experimental class only. (45% of experimental class parents returned questionnaires.)

Question 1. From what you have seen of your child's mathematics units, do you feel the work to be ____.

Answers possible	% of each reply
Too easy	10%
Too difficult	7%
About right	68%
I never see it	15%

Comment: Apparently most parents replying seemed satisfied with the challenge the units posed for their children. The degree to which these replies were influenced by parental examination of units as opposed to their children's comments is unknown.

Question 2. Would you say that your child's attitude towards mathematics this year has ____.

Answers possible	% of each reply
Become worse	7%
Become better	54%
Not changed	39%
No opinion	0%

Comment: This question was not asked of parents of control group children, and therefore a comparison of the two groups on this basis is not possible. However these results do indicate a positive trend in attitude among experimental group youngsters.

Question 3. Do you feel that your child's experience in mathematics this year has been ____.

Answers possible	% of each reply
Useful	68%
Not useful	3%
No change	22%
No opinion	7%

Comment: The basis on which the 68% decided their child's experience was useful is not known. Whether or not there is any correlation between this 68% and the 68% answering "about right" in question 1 is not known.

4) Teacher's subjective evaluation

As the year progressed, a variety of problems were solved to the point that the program became much more effective at the end of the year than at the beginning. Among learners there was a definite settling down process. Learners seemed to become more relaxed, more self-reliant, and more purposeful. Several people made impressive gains in terms of responsibility and work habits.

4. General Comments

- While definitive conclusions cannot be made, we are encouraged to proceed with the second of the planned 3 years. There are indications that attitude towards mathematics has improved. In terms of achievement the results are inconclusive. The factors which we feel affected results negatively (page 12) will be eliminated in the second year of the program. To this end, units are in process of revision and enrichment materials have been ordered.

- Evaluation of the program should be a continuing one based on a study extending over a period of at least 3 and preferably 6 years. Over a 6 year period the comparison of groups could be made each year during the course of the entire high school experience, in order to determine absence or existence of long term trends.

- The streaming that took place in January was unforeseen. It altered the control/experimental group relationship and adversely affected the student helper scheme in the low stream. Although we prefer heterogeneous classes for our approach, the question of how best to group was not resolved. Two features of grouping scheme that seem desirable are sufficient flexibility to permit vertical movement at frequent (6 weeks or so) intervals, and grouping by interest and/or motivation rather than by achievement and/or ability.

- Team planning has been a clearly useful and very important aspect of this program.

- Response of supervisory personnel has been generally supportive and encouraging.

- The conflict between time needed to prepare units and time needed to evaluate learner progress was great enough to interfere with the effectiveness of the program. Since evaluating learner progress is the primary function of the teacher while school is in session, the task of unit preparation during the school year should be avoided.

- Noise levels in the experimental classrooms generally fell into 3 categories: silence with no talking, a moderate level of noise produced by a group of people working on their units, and a high level of noise produced by some part of the group engaged in non-productive activities. The first one was infrequent, generally occurring during group tests. The second one became the most common one followed closely by the third. Most learners came to accept responsibility for their behavior and acted accordingly. Those who did not were almost always the unmotivated and disinterested ones. Solutions to this problem were elusive, particularly in the low stream group where the unmotivated and disinterested were concentrated. Since this problem was intensified by the ability/achievement streaming of these two groups, it could be that ability/achievement grouping does not meet the needs of the kind of learners who end up in low stream groups.

- Although the units improved as the year progressed, we found them best suited for average students. The need for several levels of materials became apparent early in the year. The need arises from the wide range in reading levels and motivation found to exist among the students. In both experiemental and control groups, approximately 77% of learners were below the 7.0 grade equivalent level in computation at the beginning of the year. The range was 6.9 to 4.2, with 50% falling below the 6.5 grade equivalent level. More interesting materials, posing an appropriate challenge for the highly motivated and the non-motivated people need to be developed.

- Having learners invent examples and problems to demonstrate understanding of a concept proved a very useful device for evaluation and motivation.

- Early in the year, a number of learners expressed a desire for a return to the standard textbook approach. We felt this was due to: (a) people feeling ill at ease with the responsibility for their own learning, and/or, (b) low level readers having to rely on their own resources to a greater degree than in the past. As the year progressed, most people found the system to their liking. Perhaps people came to rely on themselves to a greater extent and certainly there seemed much less hesitation on the part of learners to ask questions of the teacher.

- Time limitations prevented an Independent Study Program from being started as originally planned.

HILROY FELLOWSHIP PROJECT 2

NEW DIRECTIONS FOR IMPARTING MEANINGFUL SCIENCE EDUCATION TO THE NATIVE INDIAN STUDENTS

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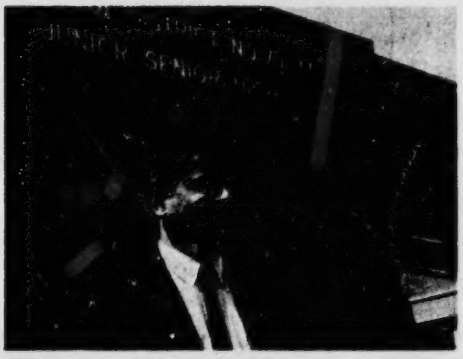

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NEW DIRECTIONS FOR IMPARTING MEANINGFUL SCIENCE EDUCATION TO THE NATIVE INDIAN STUDENTS

(a) Introduction

Most of the science teachers are aware that native Indian students are consistently disinterested in science and the lack of interest often results in failure in the subject. Because the science curriculum as it now exists presents a world which is alien to the Indian student, this disinterest should not come as a surprise. It is quite obvious that the students' interest is aroused only when he perceives something of value in the subject or sees a practical application of the knowledge to be gained. This repeated failure in science and in other subjects has led to discouragement and the resultant number of dropouts.

The following table[1] indicates the high attrition rate:

Grade	Year	Enrolment	Loss No.	Loss %
1	1951	8,782	-	-
2	1952	4,544	4,238	48.2
3	1953	3,930	614	13.5
4	1954	3,652	278	7.1
5	1955	3,088	564	15.5
6	1956	2,641	447	14.5
7	1957	2,091	551	21.7
8	1958	1,536	554	26.5
9	1959	1,149	387	25.5
10	1960	730	419	36.5
11	1961	482	248	34.0
12	1962	341	141	29.3

Analysis of the above table shows the rate of grade repetition and of dropouts is extremely high. The dropout rate of Indian students from grade 1-12 is alarming. Most of the failures are in the core subjects - Science, Mathematics and English. In the opinion of this author, the above failure is partly due to the structure of the present system of education, a structure which is based on the assumption that various Canadian subcultures such as the Indian will respond to the opportunity of receiving education and that he will understand its value to him, his family, and his community. If he does not reach this level, of course, he is "just a dumb Indian". As a result of this assumption very little credit is given to their rich Indian cultural heritage in the present system of education.

The fallacy of this assumption has been aptly described by Chief Dan George. "Don't strip a man of his clothing and ask him why he is naked . . . don't flitch a man of his authority . . . his right to rule his home . . . his dignity as a man and then ask him why his culture is sub-standard."[2]

In this age of modern technology and academic achievement these native Indian students are conscious of the phenomenal advancement of European and post European cultures, but at the same time they perceive that their culture has contributed little to the present syndrome of technology and feel it is too late for them to make a significant contribution to the society in which they must live.

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[1] H.B. Hawthorne, A Survey of the Contemporary Indians of Canada (Ottawa: Indian Affairs Branch; Vol. II, 1967) p. 130

[2] Chief Dan George, Canadian Conference of Social Welfare, Vancouver (B.C.) 1967.

Nowhere is ruthless effacement of a people's pride in their own achievements more evident than in current educational practice regarding native Indians. Here is a people whose culture was solidly science based long before modern technology came into existence, yet this fact is ignored in the present teaching curriculum. Have their achievements in applied science, agriculture, construction, and mathematical manipulations been so useless to be given no consideration in the present science curriculum?

(b) Purpose

(i) The first purpose of this project (Part I) is to illustrate the extent of native Indian scientific achievements and to try to correlate the resulting information with the science concepts taught in schools. Hopefully, the native Indian students may develop pride in their scientifically rich heritage, develop an interest in learning to understand the world in which they live through an understanding of science, and consequently achieve satisfaction from success.

(ii) The second purpose of this project (Part II) is to make some practical suggestions to teachers and prospective teachers, administrators, school boards and Indian parents to make the science education more meaningful to the native Indian students.

(c) Age and Other Significant Characteristics of Pupils

(i) Elementary to Secondary level. More emphasis on Junior Secondary and Senior Secondary students (13-19 years).

(ii) Canadian Indian students.

(d) Procedures Followed

Steps Taken and Procedures Followed Up to Date of Reporting

Part I

I. Personal Interviews

(i) Personal interviews with Indian parents residing on and outside reserves (February 2, 1971 to June 9, 1971).

(ii) Evaluation questionnaires to be completed by the native Indian students attending schools in the Lower Mainland districts of Maple Ridge, Mission,

Surrey, Aggasiz, and North Vancouver, (February 10, 1971 to June 9, 1971).

Many of the questions in this tool were suggested by the native Indian parents thus projecting their doubts in the present system of education.

In the opinion of this author, as this project is concerned with the native Indian people, they should be given a major role in directing some of the above research. Therefore, the given questionnaires are true representations of their apprehensions in the education system.

II. Illustrations of the Extent of Native Indian Scientific Knowledge

Indians applied sophisticated scientific knowledge to almost every dimension of their life. In the realm of clothing, in the construction of dwellings, in the means of acquiring or growing food, applied science was vital.

The following are some examples of Indian scientific knowledge which could be easily incorporated into any school science curriculum.

A. Native Dyes and Natural Dyeing[3]

Indian women were experts in the use of vegetable and other dyes. Alder, when freshly cut, is soft and white but becomes red upon atmospheric exposure. Hence the bark formed an effective dye, for when chewed the red became brighter and remained a permanent pigment. The question immediately arises in one's mind. How did these women discover that the substances they used for all these dyes had the property of directly fixing themselves in the texture of the material to which they were applied -- a property which fore-shadowed the more complicated processes of today, when a mordant is used to fix the diversity of dye stuffs employed?

The ancient Indians made little effort to produce ornamentation from colour in the weaving of blankets or other items. Most of the basic colours produced in both woollen and fibre materials were black, yellow, orange and brown.

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[3]Alice Ravenhill, The Native Tribes of British Columbia (Victoria: Charles F. Banfield, 1938) p. 65.

Black - Sk'ayq - was produced by the boiling of Hemlock or Birch bark with mud containing iron. If an iron pot was used for boiling, the mud was usually left out.

Yellow - *Skwiy - was produced from the yellow lichen (Evernia Vulpina). The lichen produces a vivid yellow colour when immersed in water and brought to a boil. The wool was then submerged in the dye bath until the desired colour was attained.

At present, the Salish Indians are producing these colours with modern mordants such as Alum, Chrome and Tin. The primitive mordants used by these people to fix colours were urine, iron and copper.

B. Production of Yarn and Thread[4]

The native Indians displayed extensive scientific knowledge in their use of the natural fauna and flora of the country to satisfy their requirements for food, clothing, and shelter.

Recent scientific research in the area has revealed some interesting information and the older native people of the present day have contributed local details of interest, which illustrate Indian uses of the natural sources of their environment.

The following methods have been taken from Arts and Crafts in Chilliwack[5] (British Columbia).

Mountain Goat's Wool - *SAH-ay

Originally obtained by the Salish by picking shed wool in the high mountains where the Mt. goats spent the summer and shed their old wool. Also obtained from the skins of goats killed for meat. The fresh skin, rolled up with flesh sides together, will, after several days, shed the wool which was plucked off for use in yarn making. The coarse, guard hair of the fleece were removed. A white chalk-like clay was added to the wool, absorbing the grease and leaving the wool with a tendency for the fibres to cling together. Wool was then spun into a loose length of yarn, which was later attached to a spindle with which the native spun a yarn suitable for the use intended for the wool.

---

[4] Oliver N. Wells, Salish Weaving - Primitive and Modern (Sardis: Oliver N. Wells, 1969) pp. 4-20.

[5] Ibid., p. 7

For the warp of the heavy blankets, two of these strands of yarn were spun into one double strand of warp, simply by attaching the ends of two separate pieces of yarn to the spindle. As the spinning proceeds, the yarn is drawn from two balls, each in a separate container. Domestic wool has almost entirely replaced the Mt. goat wool, which is now rarely obtainable.

Dog's Hair - *TSAH-ee

The Salish kept dogs for the purpose of wool gathering. These dogs, among some tribes were recorded to be of a Pomeranian type, mostly white in colour. The Chilliwack tribe had dogs which were similar to a coyote, with a deep, wooly undercoat covered by coarser long hair. The dogs were plucked for their wool. Dog's hair was then spun on the primitive spindle. During the spinning process, when the yarn was to be used for fine garments, the down of water fowl, or the down of the milk weed, or fire weed was often incorporated with it.

Cedar Bark - *SLAH

The bark of the Cedar trees which grew so prolifically in the land of the Salish was used in many forms for many uses.

For weaving the inner bark of the trees was used. After the bark of the trees had been stripped from the trees in long ribbons, the inner bark was separated and stripped off.

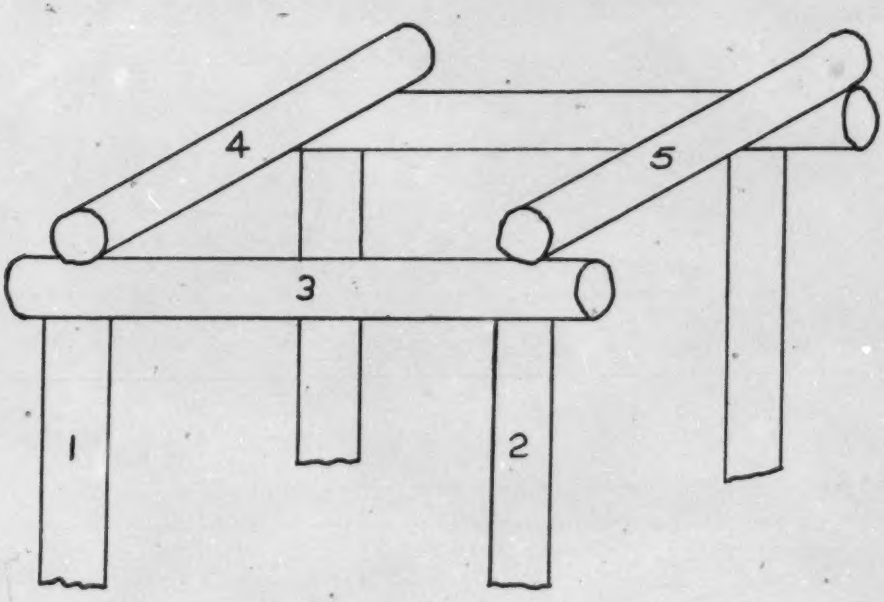
To make it soft and pliable, it was boiled for periods of up to two days. The wide strips were then worked into a soft pliable condition by bending and twisting and rubbing between hands covered with buckskin gloves for their protection. When the bark was soft and pliable, strips of desired width would be torn off ready for use in plaiting, or open-work basket weaving. If the work being undertaken required a finely spun material, the bark strips were pounded into shreds and combed into small separate fibres. These were then spun into a fine twine, or heavy cord as required. The bark of the Yellow Cedar was preferred to that of the Red Cedar.

C. West Coast Indian Houses

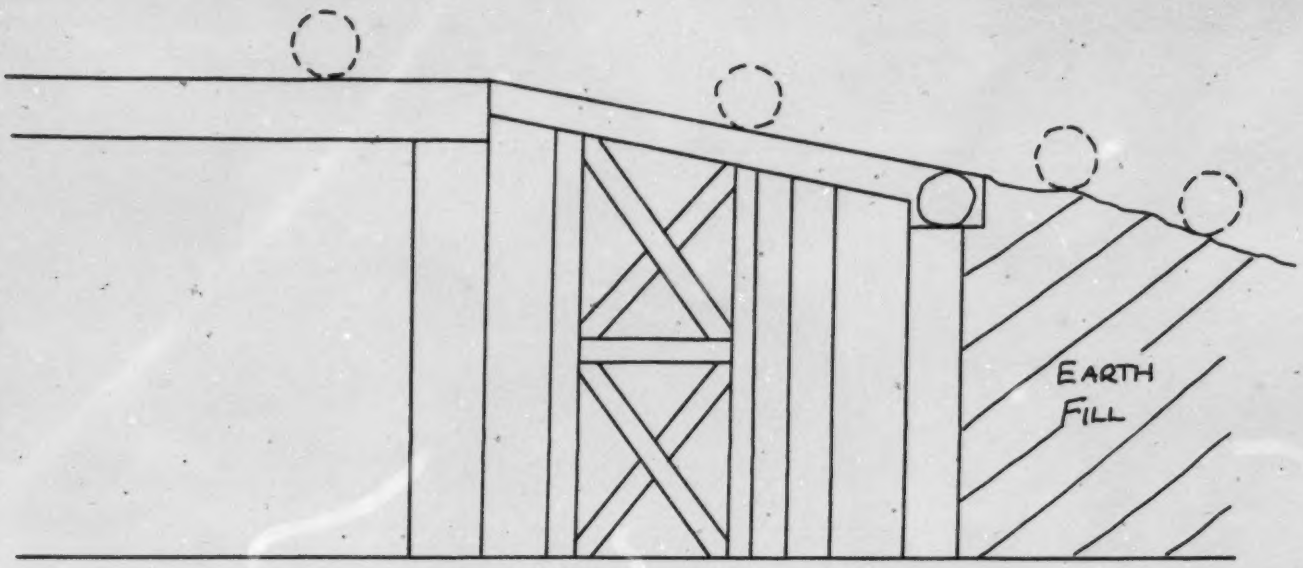
Sophisticated engineering knowledge was obviously required in order to construct the native Indian large meeting halls and houses (Refer to picture, Appendix I).

Possessing no machinery of any kind, the native Indians moved gigantic tree trunks used to construct the frame work for private dwellings and "long house" meeting places.

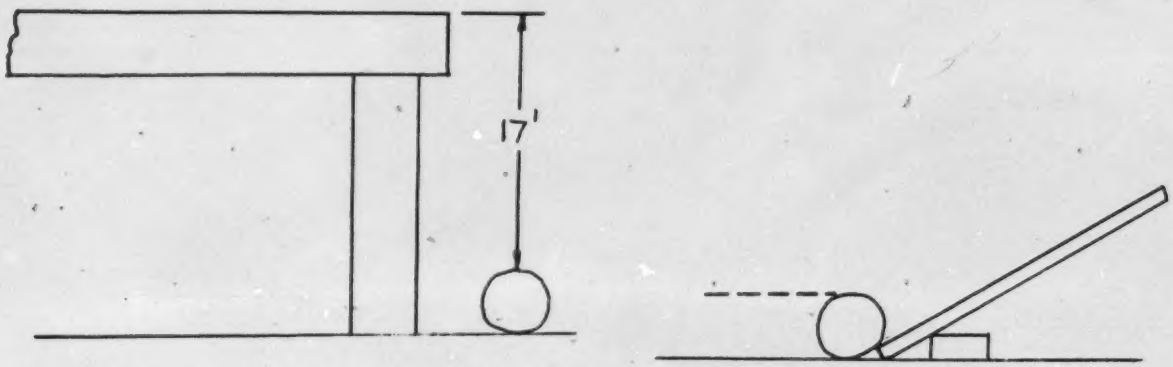
These achievements demonstrate knowledge of the concepts of Lever, Force, Moment and Torque possessed by these native Indian people. The main superstructure of a Kwakiutl Community House is aptly described by Rev. Ernie Willie (Native Indian) in the following passage.



No's 1 and 2 form one of two pairs of heavy upright posts which are 15 ft. in length and spaced 10 ft. apart at the ends of the proposed house. Each pair of posts were united at the top by a horizontal beam (No. 3). The arches thus formed were joined by the two main beams (No. 4 and 5), each approximately 3 ft. to 4 ft. in diameter, 50 to 70 ft. in length, and often weighing as much as 5 to 6 tons. Each beam had to be lifted 17 ft. to the top of horizontal beams directly above the upright posts. This task was accomplished in two different ways.



Method I: As in the diagram above, earth was built up to form a ramp extending as far as the secondary support beams, which formed the sides of the house. A ramp of logs, planks leading from the secondary support beams to the top of the supporting posts was constructed so that the main beams could be elevated to their final position. The beams were rolled up the ramp by man power aided only by ropes.



Method II: The second method made use of leverage and blocking. This tedious procedure was repeated inch by inch until the beam was level with the top of the horizontal beam. It was then rolled into position atop and directly over the post.

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D. The Indian Way of Life - A Scientific Study of Environments

The above illustration is a reproduction of a painting by George Catlin, who visited many Indian tribes in the nineteenth century and left a valuable pictorial record of the Indians' mode of living - a way of life that demonstrates their scientific understanding of the environment.

The Indian's keenness of observation[6] is furthermore displayed in his skill in fishing and hunting. Few Europeans have equalled them in these pursuits, except when superior equipment has given them an initial advantage.

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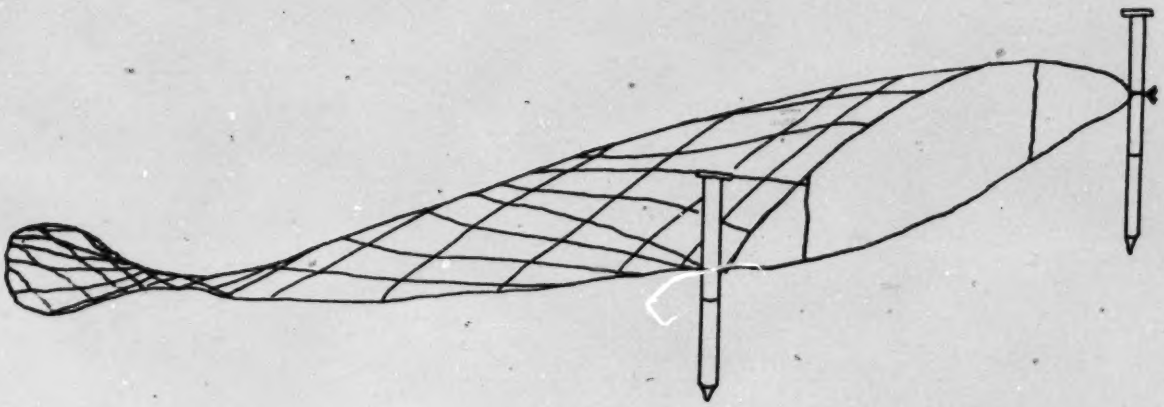
[6] A.E. Pickford, British Columbia Heritage Series (Victoria: Department of Education, Division of Curriculum, Vol. VIII, 1953) p. 20.

Scientific knowledge of the habits of fish was explained by Rev. Ernie Willie (during the author's interview).



A net trap in the shape of a cone was hung between two posts (eight feet apart) driven into the river bed. As the small oolichen (candle fish) rested or slept, they drifted down streams into the traps which had been set at appropriate times. These fish were desired not as food but as a source of oil. The loads of fish were dumped into open pits on the ground covered with cedar boughs and left for approximately two weeks. The decaying fish were then transferred into vats of boiling water. The oil was carefully skimmed and then filtered to give the purest fish oil.

Other fish such as Salmon were caught with spears, nets or traps. Much of the fish caught was preserved by drying in order to provide a winter food stock. After the fish had been filleted, they were rocked and placed near the intense heat of burning Alderwood in order to seal in flavour and dehydrate the flesh. The longer the dried fish was to be kept before eaten, the longer it was smoked. When the time came for the fish to be consumed, water was added and a nourishing meal resulted. The only difference between this food and contemporary dried food stuffs is that the fish was not powdered and packaged.

The dehydration process was also used in the preserving of clams, mussels, berries and meat.

The Indians, keen naturalists, knew the life histories of the animals they hunted, the various stages of their growth and their seasonal movements. Rev. Ernie Willie describes the application of the environmental knowledge.

> My people know well the habits and characteristics of the animals and fish they hunted on land, sea and air. The Indians knew intimately; for example, the life cycle of the seals. They knew how to locate the underwater entrance to their homes and how to discover their favorite feeding places. They knew the life cycles of animals and in what season the game was at its best to kill. The deer, for instance, is at its best just after it comes down from the hill country to the foot hills. It has had a great deal of mineral fed grass in the uplands, and because it is nearing the cold season it is firm and getting fat. In early fall, then, the deer is at its best. It was common knowledge that one does not hunt them in early spring or breeding season, for he might kill the doe while it is bearing or kill the buck when it is yet to perform. Winter is the best time to get ducks, not in the early spring.

Their interest in their environment and their eagerness to experiment led to their discovery of the medicinal properties of many plants. According to Sproat, the Nootka were well versed in local plants and knew at just what time of the year each plant should be gathered for medicinal properties. Oregon grape, for example, was known for its excellent tonic use.[7]

E. Indians as Agriculturists[8]

As agriculturists the Incan people have never been equalled. They were agricultural wizards and had developed agriculture into a fine art. By means of vast irrigation systems in a land that is mainly arid and dry, they cultivated over eighty percent of the vegetables and fruits we know today. They had developed and hybridized, for example, maize, potatoes and peanuts.

Agriculture in Peru, in the era of the feline cultists (roughly the 1,000 years preceding the Christian era), cultivated squash, goards and beans. The use of fertilizers (guano) was learned.

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[7] Diamond Jennes, The Indians of Canada (Ottawa: National Museum of Canada, Anthropological Series No. XV, 1955) p. 53

[8] A. Hyatt Verill and Ruth Verill, America's Ancient Civilizations (New York: G.P. Putnam & Sons, 1952) p. 118

F. Indians as Scientists[9]

When astronomy, meteorology and physic were as yet unborn in European nations, the Indians interpreted the phenomena of nature in spiritual terms, projecting their own beliefs into processes they saw at work around them.

As observers of the heavens, they had invented many astronomical devices. For their solar observations they used a simple but accurate device known as Inti Tihuayana, which means "resting place of the sun". Various astronomers have worked at the problem of determining the alteration of earth's axis using the ancient astronomical device of the Tiahuanacans.

The native Indians were well aware of the medicinal properties and effects of many natural compounds derived from plants. Most of our widely used drugs were cultivated and used by Indians of North, South and Central America many centuries before Columbus discovered America. Among these are Cocaine (from the coca plant of Peru). Quinine and Calisya, Sarsaparilla, Impecachuane, Rhubarb, Wintergreen and Sassafras (sources of salicylic acid and asprine). Medicine, surgical and herbal were well advanced.

From the Chimus' portrait vessels it appears that Indian surgeons were doing both minor and major operations. Other Pre-Incan surgeons performed major operations, e.g. amputated limbs, abdominal operations, removed injured or diseased internal organs and filled and crowned teeth.

The above surgical operations are also demonstrated by showings with all the fine details, skeleton and amputated limbs. Artificial limbs and hands were also known as illustrated by the pottery vessels showing men wearing artificial legs and arms. On a few specimens there are detailed pictures illustrating a man in the process of removing an artificial hand from the stump of his forearm.

The native Indians had their own measuring devices. Their numerical system was decimal. All measurements were based on the primitive digital five or fingers of a hand. Measurements of lengths were marked with TUPU Stones showing the distance from one tambo to another.

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[9] Ibid., p. 165-264.

Long Measure	Inches
Yuku (or one hand)	5
1½ Yuku made 1 Kaipa	7½
2 Kaipa made 1 rhokok	15
2 rhokok made 1 sikia	30

Survey Measure

Thatkaiy - 5 feet (60 inches) equal of two sikias.
5,000 thatkaiy made 1 turo - 25,000 feet.
30 tupos made 1 yuamani - about 135 miles (or 120 tupu miles).

The greatest engineering feat of these people was the so called Incan Road. This road started from Quito in Ecuador and stretched to Tucuman in central Chile. No Europeans ever constructed such a highway.

Fig. II. Northern designs illustrating the method of two-dimensional application of three-dimensional concepts. The figures are portrayed as if they had been split and spread out flat (see detail of hat, top right). These examples are Haida, but Tlingit

and Tsimshian artists used this technique, too. Top left, a Beaver design from a basketry hat; center, a sea monster painted on a screen; lower left, carving on a wooden hat (seen from above) representing a sculpin; lower right, a tattoo design representing a "wasago", a being which combined characteristics of the whale and the wolf.

Picture II illustrates the method of two-dimensional application of three-dimensional concepts. It proves that these native Indians knew about the above concepts which are very abstract and highly mathematical in nature.

From the tombs and graves at Chan Chan many articles of copper, plated with gold and silver are available. The above articles demonstrate that they were electroplated. However, because we know that these people could not have possessed any knowledge of electricity, it is obvious that they knew some other process of coating one metal with another. This could have been accomplished by some chemical process i.e. electrolytic process or by employing some unknown adhesive.

The Indians were aware of the scientific principle that sound can pass through the ground. When they wanted to hear sounds from a distance they kept their ears to the ground and listened. This proves that the above principle, that sound can pass through solid phase, was known centuries ago by the native Indians.

The Indians knew how to shoot an arrow straight through the air. They put feathers at the end of the arrow to keep it in a straight line. The same principle is used in building "tail fins" on airplanes to make the planes fly in a straight line.

The Indians were aware of methods which were conducive for plants' growth. For example: They put fish into the earth when they planted corn or tomatoes resulting in the better growth of vegetables. Modern farming uses the same above method i.e. feeding the earth with animal waste for better growth of plants.[10]

The author has tried to collect these achievements from various sources e.g. (i) books, (ii) local Indian people.

As there is a lack of written material regarding their achievements it has been very difficult to obtain the above information.

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[10]Tillie S. Pine, The Indians Knew (New York: McGraw Hill, 1957) p. 5-20

In the opinion of this author, the science teacher should be familiar with the native Indian scientific culture before correlating the above information with the contemporary scientific concepts.

However, for the convenience of the science teacher, some of the examples of the concept of high school science are provided with reference to the native Indian Culture.

Topics in Science	Correlation with the Native Indian Culture
(a) Concept of observation, generalization and scientific attitude.	(a) (i) Indian, keen naturalists knew entire life histories of the animals - how they hunted, their various stages of development and their seasonal movements. (ii) The Indian's keenness of observation is further displayed in his skill in fishing and hunting.
(b) Concept of Lever, Force, Momentum and Torque.	(b) Sophisticated knowledge of these concepts was obviously needed in order to construct their large meeting halls and long houses.
(c) Electroplating	(c) From the tombs and graves at Chan Chan and elsewhere within the Chimu Area have come many articles of copper, plated with silver and gold.
(d) Spectrum	(d) This concept can be correlated with their practice in the use of colours.
(e) Invention of Drugs	(e) Most efficacious and indispensable medicines and drugs are of American origin and were widely cultivated and used by the Indians of North, South and Central America, many centuries before the conquest e.g. - cocaine (from the coca plant of Peru), Quinine.

(e) Modifications, if any, Made to the Original Purpose of Plan

It is difficult to get any reasonable response from the elementary students. Therefore, the above research is mainly directed towards the secondary level students.

Mission Secondary School library has purchased many informative and interesting books on the Indian Heritage. Therefore, the money originally reserved for library books has been utilized for editing and interpretation.

(f) Source or Resource Materials in Use

1. Books pertaining to Native Indian Heritage.

2. Discussions with the educated persons of the Indian community.

3. Indian Heritage material from the:

   (i) Department of Indian Education, University of British Columbia, Vancouver.

   (ii) Fraser Valley Libraries.

   (iii) Western Washington State College, Bellingham, (Cross Cultural and Ethnic Studies).

4. Interviews with old native Indian people on the reserves. Indians applied sophisticated scientific knowledge to almost every dimension of their life.

5. Approximate Cost - $1,600.00

   (i) Includes a fee for editing and interpretation.

   (ii) Visits to various Indian reserves (approx. 70 miles from the place of author's residence).

   (iii) Pictures and interviews on the reserves.

   (iv) Visits to various School Boards for evaluation questionnaires.

   (v) Visit to Cross Cultural Ethnic Centre, Western Washington State College, Bellingham (U.S.A.) and other educational institutions.

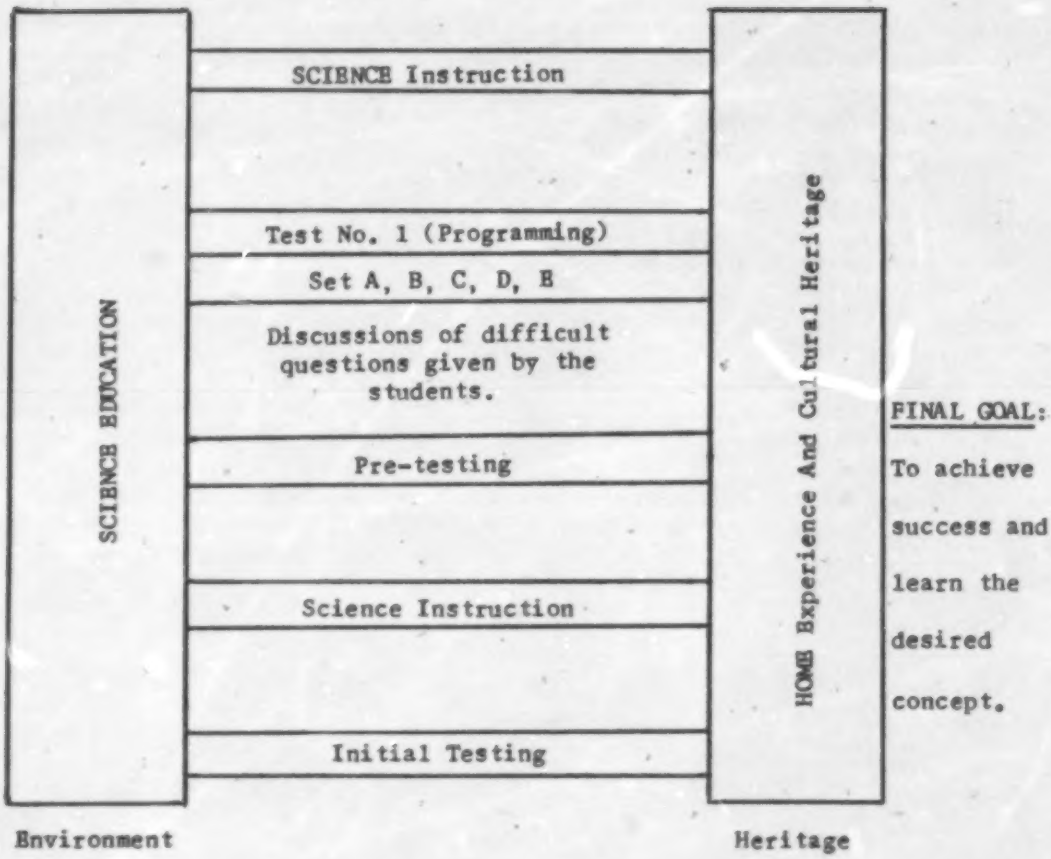
   (vi) Typing and Binding - approx. $60.00.

   (vii) Entertainment: Invitation to some native Indian people to acquire their confidence in the author.

(g) Evaluati. Procedure Planned

Our present system of grade placement of students, although based to an extent on the idea of maturation level, in effect hinders the application of what might be learned from research. Chronological age and mental age do not always correspond and thus many students who are taught in the same class by the same methods and using the same instructional material are neither ready to understand the material nor are they ready to advance to more complex forms of learning. In essence, they are prevented from doing so by their grade placement. The problem of evaluating of native Indian students is even more complicated because they are generally not interested in the material offered in the present science course, usually results in failure and frustrations. Satisfaction will come from success, and success will result when interest is aroused.

In order to give the feeling of success to the native Indian students, we have to change the present system of evaluation. Instead of giving a D or E for poor achievement to a native Indian student, the science teacher should give extra help or time and design evaluation to help them attain more subgoals which lead to mastery. This method of individualization incorporates the following concept of evaluation which I have found quite successful in my science classes, especially with the native Indian students and under achievers.



Schematic Representation of an Evaluation which recognizes the different Cultural Background and degree of science proficiency.

The evaluation procedure suggested above is comprised of the following steps.

STEP I - Initial Testing

The tests are designed to find out the previous level of achievement in science. If a science teacher is aware of the previous science background of the native Indian students, he would be able to develop an individualized program of studies designed to correct deficiencies and satisfy needs according to the ability of the student.

STEP II - Science Instructions

There are few methods of teaching science. Methods (like the Historical Method, The Lecture Method, The Heuristic Method, Normal Experimental Method, The Project Method and The Unit Problem Method) have from time to time been suggested, but have never been formulated into definite schemes.

The following brief outline gives an idea of suggested procedure for science teaching to these native Indian students.

(a) Announce a day early, the subject matter to be studied.

(b) Give the historical aspect of the subject matter under study. Try to introduce the concept in science with reference to the native Indian culture in order to develop pride in the competence of native Indian scientific achievements.

(c) In a selected unit of science which can be studied experimentally, help the students in interpreting the experimental facts.

(d) Science fairs should be arranged and the native Indian scientific achievements should be displayed. Native Indian students' participation in these fairs should be voluntary but encouragement to any student is often required. The projects in the fairs must supplement the teaching of science.

(e) Some outside experiments and field trips are essential in science teaching.

(f) Incorporated into the science curriculum should be native Indian scientific knowledge that existed before the coming of a white man.

STEP III

After imparting instructions on certain scientific concepts, for example, Mole concept in senior chemistry, the science teacher should have a "Pre-Test". The purpose of this test is to find out the concepts which have not been properly understood by the students. Furthermore, the students are

asked to hand in questions for discussions and for use in quizzes. The student may use any format they wish - objective type, semi-objective, fill in the blanks or programmed type. These questions and the students' participation in these discussions are also considered a part of the evaluation.

STEP IV

The next step is Exam A. The exam consists of quizzes based on programmed as well as semi-objective type questions. The students will be asked to take a quiz on each of the science units or textbook chapters as they occur.

In order to take quizzes on subsequent chapters or units, the students must pass the quiz on the preceding chapter or unit. Passing is 50% and the students may take each quiz as many times as is necessary to pass it. However, as an incentive, liberal time limits for the passing of these units should be set by the teacher.

The evaluation procedure suggested above allows the students to proceed at their own rate which is compatible with the native Indian philosophy of time and the completion of task.

The method of evaluation suggested above also takes into consideration the fact that some of the brilliant students may complete the exam in less than prescribed time. To satisfy the fast learners, the science teacher should give some extra difficult assignments or quizzes for these students and an extra credit (C+, B or A) should be given for this extra effort.

The author got very encouraging results by implementing the above evaluation procedure. Students' progress and interest in the subject was quite evident.

(h) General Comments

Pupil Responses: Satisfactory to good.

Unforeseen Factors: On some of the reserves the author has received very little co-operation from the native Indian parents. They don't seem to be interested in any system of education.

Approximate cost: $1,600.00

Part II

I. Suggestions to Science Teachers and Prospective Teachers

We, as science teachers, are aware that most of the native Indian students are disinterested in science.

In order to remedy this condition one must first establish who or what has caused it. Is it the science teachers or the native Indian students or the present system of education?

In the opinion of this author, the fault lies partly with science teachers, the system of education, and also with the native Indian students for their negative attitude to the study of science. The present faulty system of education has been discussed in Part I of this project.

Many science teachers have been at fault because they have endorsed and practised only conventional and often reactionary methods of teaching and learning. Furthermore, that these students need individual recognition and attention is quite apparent. The achievement of this ideal can be realized through the establishment of personal relationships and understanding with the native students.

Following are suggestions to science teachers and prospective teachers as to how the teaching of science might be made meaningful to the native Indian students. It should be kept in mind that these suggestions are not meant to be prescriptive nor are they necessarily applicable in all situations.

A. Correlating Science with Native Indian Culture

Not only must the science teacher provide the basic material to be learned, but he must also develop in the student, skills necessary for subsequent learning. To accomplish this, the subject matter must be linked to the understanding that the child already possesses and to his life in general.

In the average school, the majority of students come from backgrounds similar to that of the teacher. The teacher is thus in a position to interpret and project ideas to the students from a common cultural tradition. Problems arise when a student does not share the common life orientation. The teacher must encourage native students to take pride in their own scientific culture and to attain this objective, the western concept of science should be introduced with reference to their culture.

However, for the convenience of the science teacher, some of the examples of the concept of high school science are provided in Part I of this project.

B. Developing Pride in Indian Scientific Culture in the Science Class

The most important thing a science teacher can do is to develop pride in the Indian Scientific Culture. Also it is necessary for a science teacher to believe basically in the competence of the Indian students with whom he works. The teacher must stress their achievements in science in a class. For example, Chimu surgeons performed many operations that are a credit to the medical profession of today. These surgeons amputated limbs, trepanned skulls, performed major abdominal operations and filled, crowned and bridged teeth. There are so many achievements in the fields of other sciences such as Agriculture, Engineering and Astronomy which have been suggested in Part I, that can be discussed in an integrated science class.

Therefore, a science teacher who is teaching in an integrated class must gain a knowledge of the rich Indian Scientific Culture in order to impart the meaningful scientific knowledge to the native Indian students.

Some Practical Suggestions for Developing Pride in a Science Class

(i) The science teacher should become acquainted with the scientifically rich culture of the Indian students in his class. This will cultivate better understanding and rapport.

(ii) The science classroom should be liberally decorated with all aspects of Indian Scientific achievement. For example: Pictorial representation of their scientific way of life should be displayed.

(iii) The science teachers should discuss the facets of the Indian Scientific Culture which appear to be superior to those of the dominant culture. E.g., Indians excelled in fishing and hunting. Their knowledge about animal life was very close to perfection.

(iv) The science teacher should invite elders of the tribe to visit the classroom and display their customs, crafts and dyeing techniques.

(v) The science teacher should try to correlate contemporary scientific principles with the native Indian scientific achievements.

(vi) The science teacher should encourage Indian students to form a social unit or science club. In the assemblies Indian and non-Indian students could investigate and discuss together the customs, traditions and scientific know-how of the North American Indian people.

(vii) The science teachers should also give "Model examples of the native Indians who have been quite successful in their lives and have graduated from the present school system, in order to overcome the prevailing idea that success in the white society is not possible. Some of the biographies of the successful native Indians are found in Appendix II.

In the opinion of this author, the native Indian students might get inspiration from their people who have schieved success through the present educational system.

C. Compatible Relationships with Students

Teachers should form compatible relationships with these students in order to illustrate value and instill confidence in the school and in themselves.

Interesting facts lie behind the statistics, one, for example, is the students' almost universal definition of what makes a good teacher.

> He's young . . . has a sense of humour . . . listens and understands . . . doesn't just go by the book . . . encourages discussion and participation . . . treats us like grown ups . . . gives us responsibility . . . always listens and is free and open with us . . . is interested in us and thinks like a kid.[11]

Pilot studies undertaken in the Hawthorn report[12] indicate that Indian students stayed home from school because they were "afraid of teachers", they "did not want to be ridiculed" and they "just didn't like the school". When asked what they feared, students

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[11] Louis Harris, "What People Think About Their High Schools", Life, (Chicago: Time Inc.) May 1969, Vol. 66, p. 130.

[12] Hawthorn, Op. Cit., p. 136

responded that they feared being brought to the attention of the class or yelled at.

In the opinion of this author the science teachers must realize that an Indian student is not to be classified with other minority groups that are in Canada. The Indian did not come to Canada to find a new way of life. He was already quite happy without anxiety, ulcers and pollution which are the contributions of the dominant culture.

D. Academic Games in Science Teaching

A student's interest is aroused only when he sees a real use in what he is studying and when it satisfies some felt need and provides some value he accepts.

Accordingly, teachers must provide the environment which affords both experiences desired by the student, as well as a basis for the formal educational goals of the school.

To motivate these students, an activity is required that takes them out of the classroom atmosphere, and which seems to them, at least, to be a non-school activity.

The native Indians (Bella Coola, Salish and Nootka), like all students, played a number of games. Guessing was the distinguishing feature of the games which were played with bone sticks. "Chemical Charade" and "Chemical Password" are two guessing games that the author has successfully introduced into his Chemistry classes. Chemical Charade is a game in which the students try to guess the right element, compound or substance acted out by an actor designated from the class. In some way it resembles LEHAL, the native Indian past time in which the opponent is expected to guess the location of certain hidden sticks.

The above academic games are found in Appendix III.

E. Field Trips

The native Indian students are in favour of having more field trips in the science course.

In the opinion of this author, these field trips, if handled skillfully, are very effective in making science subjects real and interesting.

In order to achieve any constructive information from these field trips, the activities should be thoroughly planned and correlated with the course content or study

unit. Before the field trip, the students should be told the definite purpose of the field trip. After the completion of the field trip, a comprehensive discussion should be held in order to make the experiences and activities of the field trip more meaningful to the students.

F. Experimental Research and Methodology in Public Schools

A continuous research program concerning the problems of the science teaching of Indian students in public schools should be established. Frequently, financial grants should be provided to the science teachers who are engaged in this research.

G. Special Training for Science Teachers

Special training for science teachers working in integrated schools should be provided in order to familiarize them with the Indian Cultural background and the psychological background of these students. Furthermore, the Indian Affairs Branch should encourage the training of competent Indian teachers by offering them financial assistance.

H. Linkage with Future[13]

To provide a meaningful link between the science education of the Indian child and his life needs, there must be a restructuring of employment opportunities so that native Indian students can find a self satisfying place in society.

Knowing that the attainment of a high school diploma leads, more often than not, to menial dead ended jobs, certainly offers little in the way of incentive in school. Indian students have the impression that they are "no body" and functioning in "no place", we should be providing a learning experience which gives them a sense of contribution and personal worth, hope for the future, and a certainty that they have a place in the economic and social life of the country.

I. Linkage with the Past[14]

Any child who is deprived of stimulation is likely to be different. Indian and non-Indian children have different psychological backgrounds. Of which a

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[13] Educational Change: Why - How For Whom: From Speeches of Dr. Arthur Pearle, Department of Education, University of Oregon, Oregon, U.S.A.

[14] Hawthorn, Op. Cit., p. 112-116

science teacher must be fully aware.

The following are some of the major differences between an Indian and non-Indian child.

	Indian	Non-Indian
I.	(a) The control by parents is minimum.	Control by parents is maximum.
	(b) Child is regarded as a person.	
	(c) Minimum feedback is available from adults.	Maximum feedback is available from adults.
II.	(a) Child is allowed to gain experiences which interest him.	Desirable experiences are encouraged and often selected.
	(b) Life is not time orientated.	Life is rigid and time organized e.g., bedtime and suppertime.
	(c) Broken homes and unstable family background common.	Normally stable family is existent.

J. Homogeneous Grouping

No studies have found that the Indian child is less motivated to succeed than the non-Indian. Pilot studies undertaken during the course of Hawthorn Project[15] appear to indicate that the motivation of Indian students is as high as that of non-Indians and, in some instances higher. Nevertheless, the study also notes a sharp drop in motivation for achievement after a few years in school. The obvious reason for this drop in motivation is the frequent failure experienced by the Indian child.

In the opinion of this author, homogeneous grouping would be quite helpful in overcoming the above problem.

[15] Hawthorn, Op. Cit., p. 130

II. Suggestions to School Administrators and Trustees

(i) Indian parents should be encouraged to be involved in formal education in various capacities e.g.: - resource people and teacher aides, school board members in an integrated school district.

(ii) School personnel must establish friendly contacts with Indian people and must show respect for their rich heritage, but at the same time must allow Indian people to determine for themselves what "Indianness" means today. Therefore, the school must rely on native resource people in the development of curriculum concerned with the Indian heritage.

(iii) Semester system should be introduced in the school system as suggested by the native Indian students in evaluation questionnaires. (on file in CTF office)

III. Suggestions to Colleges and Universities

(a) Special training for science teachers working in integrated schools is needed to prepare them for understanding Indian background.

(b) An Indian culture course should be included in the curriculum of teacher training with special emphasis given to their scientific achievements. Surely the social structure and value system is important for imparting meaningful science education to these students.

(c) Summer courses in Indian culture should be offered and an increment in salary should be given to a teacher taking the course.

(d) Scholarship should be provided frequently to encourage graduate work in Indian Education.

IV. Suggestions to Indian Parents and Community

(a) The Indian people must unify and emphasize their culture and develop the ability to retain it and teach it to the younger generation.

(b) Parents should actively participate in educational innovations and act as teacher aides and resource personnel.

(c) A close contact should be established between native Indian parents, teachers, counsellors, administrators and school trustees.

(d) Native Indian students should be trained, financially assisted either by Indian Affairs Branch or the Indian Brotherhood and encouraged to adopt the teaching profession.

(e) Parents should give some model examples of other Indian students who have achieved success in this system of education and have acquired reasonable positions in society.

V. Suggestions on Textbooks

Indians are extremely unhappy with the type of textbooks used in the schools. The author completely agrees with the following conviction of Alvin McKay (a native Indian), Director of Indian Education Resource Centre, University of British Columbia, regarding a biased view of Indian cultural heritage given in textbooks in high schools.

> Textbooks that insult Indians by committing factual error and omitting fact should be swept out of the classrooms. And the provincial department of education's curriculum committees should guard against these types of books so they don't creep back into the classroom without being revised.[16]

Furthermore, new textbooks listing various scientific achievements should be introduced so that the Indian students might develop and learn from their culture. In Science Curriculum Guide, various examples should be given of how to correlate the scientific principles with the native Indian culture.

Conclusion

The solution to the problem of making the native Indian students interested in a science class is complex but possible.

A prerequisite for success is the instilling of pride in the Indian students of the Indian scientific heritage. To achieve this objective, a science teacher should believe in the potential competence of the Indian students with whom he works. Also the teacher must stress their scientific achievements in the science classroom.

The author does not believe in different levels of evaluation (double standards) but he believes different form of evaluation, as discussed in Part I of the project, can be quite helpful to the teachers to give a feeling of success to the native Indian students.

Also, in order to impart meaningful science education to the native Indian students, compatible relations with these students should be established so as to build their confidence in the science class, in the school and in themselves.

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[16] Alvin McKay, "School Texts Scanned for Bias" The Vancouver Sun May 1, 1971, p. 84

The above conviction has been aptly described by Chief Dan George in Dramatic Soliloquy.

> You talk big words of Integration in the schools. Does it really matter? Can we talk of integration until there is social integration . . . unless there is integration of hearts and minds you have only a physical presence . . . and the walls are as high as the mountain range.
>
> I know you must be saying . . . tell us what DO you want. What do we want? We want first of all to be respected and to feel life . . . but we cannot succeed on your terms . . . we cannot raise ourselves on your norms. We need specialized help in education . . . specialized help in the formative years . . . special course in English. We need guidance counselling . . . we need equal job opportunities for our graduates, otherwise our students will lose courage and ask what is the use of it all.
>
> But you have been kind to listen to me and I know that in your heart you wished you could help. I wonder if there is much you can do and yet there is a lot you can do . . . when you meet my children in your classrooms respect each one for what he is . . . a child of our Father in heaven, and your brother. May be it all boils down to just that.[17]

Also, in the opinion of this author, the native Indian students should also have positive attitude towards science and school. They won't achieve anything by rejecting the present system of education completely. They should try to learn from the experiences of these people who have achieved success and attained success in the present society.

Instead of cultural confrontation, cultural co-operation and integration should be established so that people from different ethnic groups can live together and learn from each other in this great country of Canada.

In conclusion, a very real and sincere effort is needed by the Indians and teachers to meet on a common ground and discuss the major problems in science education with no reservations.

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[17] From a recording by Chief Dan George, January 6, 1971, for the C.B.C. Radio Program "The Second Fifty".

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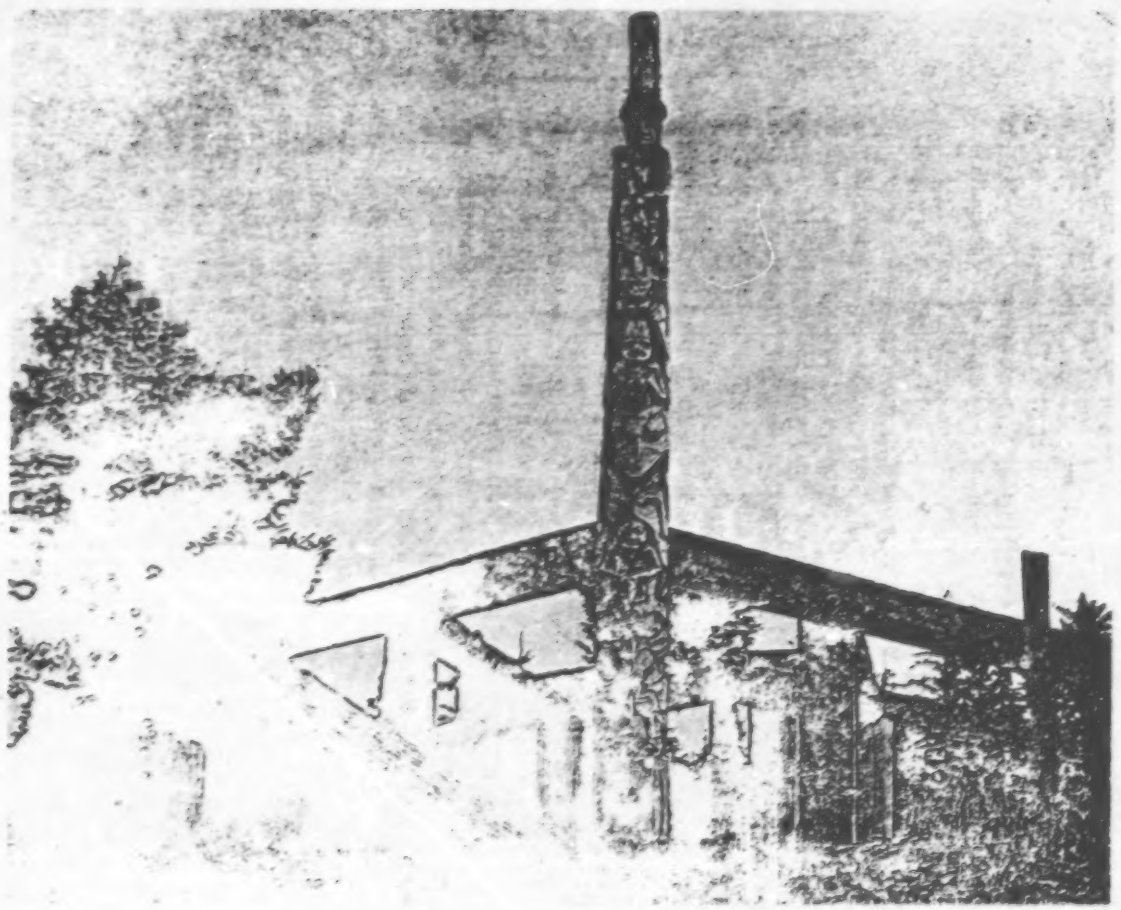
Appendix I



Framework of Haida House

Appendix II

USEFUL INFORMATION FOR TEACHERS

(Biographical Information of Some Successful Indians)

Leonard S. Marchand (Member of Parliament for Kamloops-Cariboo, B.C.)

Len Marchand, 24, an Okanagan, became the first Indian M.P. by defeating former Tory Cabinet Minister Davie Fulton. Marchand is married with two children. He has a B.Sc. degree in Agriculture from the University of British Columbia and a Masters' degree in forestry from the University of Idaho[1].

Mr. Len Marchand describes his school life in the following paragraphs.

I went to the reserve day school for grade one to eight and to Kamloops Indian Residential School for grade nine. I took my high school in Vernon and even though I was the first student from our reserve to go to Vernon High, I thought it was great. I did feel a little apprehensive and a little lost for a while, but my parents had friends in town and so, I found friends in high school that I'd known for quite a while. In a couple of months I was right at home and made a lot of new friends.

I completed high school in the general program, then found I didn't have the required courses to go on to University, so I decided to take an extra year and pick up the subjects I needed for University entrance. In October of that year, when the first report card came out, I had a D in one of the Maths and a D in something else. I was leaning on my locker outside the classroom just after I got my card. I decided I was going to quit, just going to pack it up. This was just not for me. One of my friends, a teacher, said: "Why don't you give it another try and see if it works". So, I went back and on my next report card my lowest mark was a C. I kept going and by the end of the year, I was recommended in all of my subjects. That was a really critical time in my life.

There were other people whose advice helped me too. We had a Band counsellor one time, James Bonneau, an uncle of mine. He used to say, "Do things yourself. Look after yourself. Don't depend on the government". His words impressed me. He'd talk about the Indian way of life, the way our ancestors lived, and the pride they had in being independent and would say, "We got along in this world as individuals before the Whiteman came".

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[1] Barbara Frum "The New Indian" Chatelaine, November 1968, p. 53.

Indians are a proud race. We have much in our past of which we are proud. Our culture can make an even greater contribution to Canada than the very considerable one it has already made. There is much about Indian life that is good and there is much for Canadians to learn about it. We have been held back but we are on the move today.

It is important for the younger Indians who are in school and at university to know that, with reasonable hope, they can aspire to become whatever they wish to become and are capable of becoming.[2]

Chief Dan George

Chief Dan George is a hereditary Chief of the Coast Salish tribe and honorary Chief of the Squamish tribe. He acted in the Vancouver Playhouse production of the Ecstasy of Rita Joe in 1968, and has recently completed films for the National Film Board. He was nominee for an Oscar Award for his role of best supporting actor in his new film of Little Big Man: On May 26, 1971 he was awarded an honorary Doctorate of Law by Simon Fraser University, British Columbia.[3]

The Rev. Ernest Willie

Indian name "Ka-Sa-Las" means "The way".

Mr. Willie grew up in Kingcome Inlet, a Kwakiutl Village 150 miles north of Vancouver. He attended St. Michael's residential school in Alert Bay and The Vancouver Vocational Institute. Before he fulfilled his ambition to become a priest, he worked as a fisherman and a carpenter. He received his theological training at Emmanuel College at the University of Saskatchewan, Saskatoon.

Mr. Willie worked as an assistant priest in the Kitsilano district and in Surrey and then accepted full parochial duties in Hatzic, a community east of Mission. On April 1, 1971, Mr. Willie became the social worker for the Squamish Indian Band in North Vancouver. He and his wife Maureen now live on the Mission Reserve in North Vancouver. They have a one year old daughter, Janine.

Michael Mitchell

Michael Mitchell, 22, an Iroquois, is one of six young Indians being trained with the National Film Board in Montreal as directors, cameramen, soundmen, so that ultimately they can produce their own films: to help reserves learn about each other, and to tell Indian history as Indian people feel it has never been told before.

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[2] Kent Gooderham (Edited), I am an Indian (Toronto: J.M. Dent & Sons (Canada) Ltd.), 1969, p. 40-43.

[3] Waubageshig (Edited), The Only Good Indians (Toronto: New Press Sussex Avenue, 1970) p. 184.

Mitchell is from St. Regis Reserve near Cornwall, Ontario. Married, with two children, he says, "We can educate our children to be able to make their way in the white world, but they have to know themselves first, their background. Too many young people feel lost between two societies".[4]

Jim Turner

Jim Turner, 41, never a treaty Indian, has been in Toronto ever since he came to the city to high school from the Indian community of Bear Island on Lake Temogami. "Five years ago I was one of the founders of the Indian Friendship Centre here, and I have never experienced any pressure to stop thinking of myself as Indian".

Turner has a B.Sc. from the University of Ottawa and teaches high school mathematics in a Toronto suburb.[5]

Alex Janvier

Alex Janvier, 33, a Chipewyan, was first in his graduating class in art at Alberta Institute of Technology in Calgary. He taught art at the University of Alberta and helped create the effective Indians of Canada Pavillion at Expo. In 1967 spring he went home to the Cold Lake Reserve to farm and paint, married and got elected to the band council. He feels, "Indians could deal with their problems if there were ways to co-exist without losing tribal pride".[6]

Vivian A. Youngman

Vivian A. Youngman, 23, a Blackfoot from the Blackfoot Reserve near Calgary, is National Indian Princess of 1968. "People generalize about Indian dropouts and drifters. My job is to try to explain the reasons behind those problems." She is a graduate from the University of Calgary and plans to teach in a city high school where she can work with young people counselling on Blackfoot about school opportunities that are available off the reserve.[7]

Ernest Benedict

Ernest Benedict, 53, an Iroquois, is director of an adventurous educational project. In 1966, his North American Indian Travelling College, operating out of a Volkswagen Mini-bus, became very popular. This travelling college invites entire populations of the reserves it visits to join its program of Indian history, culture, and self government know-how.

Benedict, who has a B.A. in Sociology, lives with his wife and four school age children on St. Regis Reserve near Cornwall where he himself was raised. Mr. Benedict is presently on the teaching staff of the Indian Eskimo studies programme at Trent University.[8]

4Frum, Op. Cit., p. 53
5Ibid, p. 53
6Ibid, p. 55
7Ibid, p. 55
8Ibid, p. 55

Appendix III

ACADEMIC GAMES IN CHEMISTRY

One of the most satisfying experiences a teacher can have is to see the gleam in the eye of a highly motivated student. Intelligent and pointed questions that show a student really cares about the subject being studied, is the response every teacher desires.

A few boys and girls are just naturally highly motivated, but no matter how the teacher varies his classroom technique, some students still stare out of the window. Of course, some of these just do not have the capacity for the work - a problem we can accept without too much frustration. It is the student who can do the work, yet shows no interest, who represents the real challenge to the dedicated science teacher.

Now the student's interest is only aroused when he sees a real use in it - when it satisfies some felt need, provides some value he accepts, some control he wishes to possess. Accordingly teachers must provide the environment which affords both experience desired by the student as well as a basis for the formal education goals of the school.

Of course, with present knowledge - teachers must recognize - desirable and adequate motives for all of the work may seem utopian. Nevertheless, we must continue innovating interesting methods of presenting our work. For if a student is constantly held to work in which he has no interest, he gradually develops the habit of divided attention, neglect of the work in hand, pretense coupled with activity sufficient only to satisfy the one imposing the task. In short, John has failed to be involved in learning.

The burden of responsibility for apparent classroom fatigue must fall on the teacher's shoulders. The work must be made interesting. Indifference must be overcome by motivation. Repugnance must be cured by variety, and time will be required to develop a technique of working from the standpoint of motivation.

Now sometimes these youngsters can be motivated by an activity that takes them out of the classroom atmosphere and which seems to them, at least, to be a non-school activity. Because they seem like play, academic games can interest and activate learning. A student willingly prepares and practices so that he may show up well in a game. He sees that his only right to take part with the group engaged in the game is ability to aid in winning it.

Early experiments in the use of mathematics and social studies games show promise. Relay races in both spelling and mathematics are interest arousing. These games designed to stimulate interest can be likewise adapted to chemistry teaching. For example, I have successfully introduced the following games of Charades and Password to my Chemistry classes. Of course, these games, designed to break the dull routine of memorizing definitions, properties of elements and their

compounds should be used only to supplement regular teaching. These academic games can be applied in other fields of Science.

A. Chemical Charade

The most popular form of this amusement is the acted Charade, in which the meaning of separate syllables of the word is acted out, the audience being left to guess each syllable separately and, finally, the meaning of the dramatized recombination. Like ordinary charades, chemical charades is a game in which the students try to guess the right element, compound, or substance acted out by a designated actor from the class. Although this actor is not allowed to speak, the student audience is permitted to query him. For example:

1. How many words are there in the substance?

   (The actor reveals the number by holding up the appropriate number of fingers.)

2. How many letters are there in the substance?

   (Again the number is indicated by raising the correct number of fingers.)

3. Is it an element? or a compound?

   (The actor points to the periodic table to indicate an element.)

4. Is it a solid?

   (The actor points to the bench.)

5. Is it a liquid?

   (He indicates the tap.)

6. Is it a gas?

   (He waves his hand in the air.)

The designated actor may indicate properties of elements and compounds under study by demonstration. Meanwhile the class is writing the guessed elements and their properties with their uses in their note books without referring to previous notes.

Score: One mark for each correct answer entered in the notebook
One additional mark for the chemistry or chemical equation involved in the guessed substance.

Each student in turn becomes an "actor".

Few Examples of Chemical Charades

A List of Demonstratable Chemical and Physical Properties of the Element

ELEMENTS	CLUES
Na	1 - 6 letters
	2 - solid
	3 - combination when immersed in water
	$2Na + 2H_2O \longrightarrow 2\ NaOH + H_2$
	4 - unites with chlorine to form common table salt (NaCl)
	5 - $Na + \frac{1}{2}Cl_2 \longrightarrow NaCl$
He	1 - 6 letters
	2 - gas
	3 - lighter than air (balloons)
	4 - non-combustible
H	1 - 8 letters
	2 - gas
	3 - burns - gives off water vapour $2H_2 + O_2 \longrightarrow 2H_2O$
	4 - lighter than air
Neon	1 - 4 letters
	2 - gas
	3 - glows reddish-orange in vacuum tube with electricity
	4 - used in neon signals
Cl	1 - 8 letters
	2 - gas
	3 - greenish-yellow

4- poison

5 - $MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2 + 2H_2O$

6 - used in bleach compounds

7 - purification of drinking water

Al

1 - 8 letters

2 - solid (metal)

3 - light-weight

4 - good conductor of heat and electricity

5 - $AlCl_3 + 3NaOH \longrightarrow Al(OH)_3 + 3NaCl$

Hg

1 - 7 letters

2 - liquid

3 - heavy, shiny

4 - used in thermometers

5 - $Hg_2Cl_2 \longrightarrow Hg + HgCl_2$

B. Chemical Password

Equipment:

1. "A" cards containing one half of a clue of a chemical definition
2. "B" cards containing the complementing half of the definition given in "A" card
3. two holders to contain the cards
4. a scoring dial containing numbers one to ten and a moveable pointer.

Organization:

The class is divided into two teams, "A" and "B" and arranged in pairs with an opposing partners. (In this way each student participates.)

Object of the Game:

To guess the correct "Pasword" from a chemical definition or clue presented by an opponent partner. (The "A" and "B" members of the opponent pair alternately "give" and "receive" clue words, contained in a holder to prevent the opposing partner from viewing the correct response.)

Procedure:

1. The initiating "A" player places the pointer of the scoring dial at 10, he then gives a clue word to his partner.

2. If the "B" player fails to make the correct "password" response after this first clue, the pointer of the dial is moved to 9 and the turn goes to the opposing "A" player who now supplies a clue to his "B" opponent. As long as the "password" remains unguessed, the turn is passed between alternating "A" and "B" partners.

3. When a player finally guesses the correct password, he scored the point value on the dial indicated by the pointer. For example: If two clue words have been released without a successful "password" response, the point value for the correctly guessed third clue word is 8.

4. If after ten clues, however (5 given by each player) the password has still not been supplied, no "B" player scores for that word.

Some Examples of Chemical Passwords

CARD "A"	CARD "B"
Ion	Electrically charged particles e.g. - K^{+} , Al^{+3} , Cl^{-}
Symbol	Represents an atom of an element e.g. - H - Hydrogen, O - Oxygen
Formula	Represents a molecule of a compound e.g. - H_2O, $CuSO_4$
Molarity	The molarity of a solute is the number of moles of solute per liter of solution and is usually designated by a Capital M.
Exothermic Reaction	Reactions in which heat is evolved e.g. sulphuric acid to water.

HILROY FELLOWSHIP PROJECT 3

1. Name and home address of teacher:

   Mrs. Margaret McCarthy,
   Tignish, R.R. 4,
   P.E.I.

2. Name and address of school:

   Tignish Elementary School,
   Tignish, P.E.I.

3. Review of Project

   (a) Title:
   ENVIRONMENTAL STUDY

   (b) Purpose:

   My aim is to have children aware of what is going on around them; to instil in them a great desire for knowledge so that they will find searching for it a pleasure; to teach them to share their knowledge with others, and to work side by side helping one another to develop their talents well so that they may grow up to render service to others.

   (c) Age and other significant characteristics of pupils:

   I have a class of 32 pupils (Grade V) ranging from 10 to 14 years of age. Some are disinterested, a few are self-centered; there are thoughtless ones, careless ones and those who like to be spoon-fed. In spite of their faults, they have many good points and talents which in a project of this kind can be more easily spotted and given an opportunity to be developed.

   (d) Procedures followed (from inception until end of school year):

   After motivating the children and arousing a high interest and curiosity concerning the procedures employed in the building of a boat, we visited a Boat Factory. Here the students examined, and observed material, tools, machinery, etc. being used.

   The manager kindly gave about an hour of his time answering the students' questions. The students took notes. Some parents accompanied us on this trip.

Back in the classroom research was done by the pupils; discussions were held; then report booklets on different topics related to boat-building were made. Pamphlets on different kinds of fish were obtained from the Department of Fisheries and studied. Then booklets on the different kinds of fish were made.

Children wrote stories, pretending they were boats, salmon, etc. The best were posted, some were taped. Students were shown films and slides concerning the topics they were learning.

They were taken on a tour of the Confederation Centre in Charlottetown, and then went to the Parliament Buildings where they sat in on a Question Period while Parliament was in session. Here they received a tremendous welcome from Honorable Premier Campbell and the Honorable George Dewar, leader of the Opposition.

Later on they visited the Biological Research Station in Ellerslie, P.E.I. where they observed and learned about the life-cycle of the oyster for which P.E.I. is famous.

They were taken on a tour of a newspaper printing plant in Summerside. Here they saw the teletype machine, type being set, and the daily paper being printed. They were taken to a replica of a Pioneer Village at Mount Carmel, P.E.I.

The follow-up, back in the classroom, re newsprinting and the Pioneer Village had to be postponed due to lack of time near the end of June. This will be done in September when school re-opens.

We plan on a few more trips this coming term.

A few parents accompanied us on each trip.

During the year, children made models, out of masonite or wood, of buildings found in a fishing-area, also carts, scoops, wagons, etc., used in gathering Irish Moss, which is an important branch of the fishing industry in this area.

They also did paintings and collages in which they worked together in small groups.

We have an aquarium and the children enjoyed watching and studying the fish.

(e) Modifications:

The original plan was not always carried out in the order planned, but I found we accomplished much more than I had anticipated.

As I did not receive word till January that I would have the money to carry on my project, we were late getting started. I intend to carry on the project with my pupils this coming term.

(f) Source or resource materials:

Model Building Materials Bulletin Board, Books, Paints, Art tissue, Canada 70's, etc.	70.35
Tape Recorder & Tapes	96.98
Movie Camera, Projector, Screen, films	220.24
Encyclopedia	158.00
Bus Trips	70.00
Telephone Calls, Postage	12.65
Miscellaneous	5.67
	633.89
Table for Research Corner	?
Bus Trips in September & October	?

Free

Booklets from Department of Fisheries, Halifax,
" " Department of Mines, Ottawa
" " Biological Station, St. Andrew's
Films and Filmstrips from Audio Visual Branch,
Department of Education, Charlottetown
Books from School Library, Tignish Elementary
Books from Public Library, Tignish
Children brought books from home

(g) Evaluation procedures used:

Just to observe the interest, happiness, and cooperation of the pupils as they worked together on this project gave me a feeling of accomplishment. I feel I have made a worthwhile start in helping the students to help educate themselves and not to be dependent on a teacher to spoon-feed them.

They are now aware of the fact, that no matter what we have, e.g., a pencil, we have it because many people in different walks of life (scientists, miners, factory workers, lumbermen) have developed their talents well and have learned to work side by side for the benefit of mankind.

4. General Comments

Pupils have shown much interest and improvement in their work.

Parents' Day was a day of real joy. Parents showed a tremendous interest in the work being done. There is much communication between parents and pupils. The teacher-parent-student relationship is very close.

Children:

"Learning this way is fun."
"I enjoy learning things by seeing them with my own eyes."
"It has helped me with everything in school and at home, too."
"I learned to work with others better and to write and read better, too."
"I enjoy gathering information, writing stories and doing art-wrok."
"I found out how much I can really do."